SENSORY PROPERTIES AND PREFERENCES

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ABSTRACT: Common mistakes are frequent in sensory evaluation of meats and meat products. Conceptual confusion is often observed in triangular tests when add on questions are included in the testing procedures, and when descriptive and hedonic scales are mixed in profiling exercises. Similar, consumer responses are often recorded from trained, and thus biased panels.

Preference for meats seems to be most strongly affected by changes in colour/appearance and texture, and to a lesser extent by changes in flavour (that is when off-flavours are not present). It is difficult to generalize as to whether appearance/colour attributes or texture attributes are the most important.

A simplified model for texture understanding is suggested, where water/fat perception and structure perception (described by juiciness and tenderness) are orthogonal phenomena and where most other textural attributes can be explained by this structure.

INTRODUCTION: Sensory attributes are of great importance for preference. This fact is obvious to all consumers, food producers and retailers, and to researchers in meat science and technology. The relationships between sensory attributes and preference are also investigated by research teams from all over the world. The number of reports that include sensory perception in one form or another is thus large, and a review of all of these is impossible in such a short paper. For this paper, only a small number of reports is included and important contributors might have been omitted.

A large proportion of the human diet consists of meats and meat products. Preference for these products is only a part of the reason for food choice. This implies that both preference, as well as choice behaviour, are affected by endogenous (heredity, sex, age, activity) and exogenous (culture, society, economy) factors of importance for food consumption. Preference is very often considered to be a spot measure for liking and not a good predictor for repeated consumption, since this is affected by both the individuals' values and attitudes, as well as cultural factors and other cognitive structures (SIEGEL and RISVIK, 1990). Still, the product attributes, both describing usage and the sensory perception of the product, are considered to be decisive in the determination of one product's preference over another one. This assumption is especially valid if the experimental design has been set up to remove unwanted effects from the experiment. Only the relationships between sensory attributes and preference are discussed in this paper.

SENSORY ANALYSIS OF MEAT PRODUCTS: By far the greatest number of papers can be placed into two categories: 1) investigations to develop instrumental/chemical methods with a potential for substitution of descriptive sensory methodologies (SZCZESNIAK, 1963, BRADY and HUNECKE, 1985, BOURNE, 1978), and 2) investigations and descriptions of sources of variation caused by differences in raw materials, processing or handling of meat products. It is not possible to give an overview of all factors that cause variation in the sensory perception of meats and meat products, because the literature covers factors such as breed (MOORE et al, 1978, CAMERON et al, 1990, DUMONT et al, 1987, CAMERON and ENSER, 1991), weight and sex (MENDENHALL and ERCANBRACK, 1979), feeding and exercise regimes for animals (ELLIS et al, 1990), genetic variation and stress (PSE, DFD) (STABURSVIK and MARTENS, 1982, BUCHTER and ZEUTHEN, 1971), slaughtering and cooling routines (including electrical stimulation) (GRIFFIN et al, 1982, KASTNER et al, 1973, VILLARREAL and WILL, 1988, VAN LAACK and SMULDERS, 1989, FALK et al, 1975), chemical composition and physiological studies of fat and muscle fibres (VALIN et al, 1982, CAMERON and ENSER, 1991), maturation (SEYDI and TOURAILLE, 1986) and processing (CROSS et al, 1987), restructuring (FORD et al, 1978), heat treatment, use of additives in production (BAARDSETH et al, 1991), handling in the whole food chain from farm to table, leanness (GIESE, 1992, KEMPSTER et al, 1986, WOOD et al, 1986), and methods for preparation in the home (cooking, frying, microwave treatment and others).

For a long time, it has been the aim of many studies to substitute sensory descriptive work with that of instruments (BOURNE, 1978), mainly because sensory descriptive work has been seen as tedious, expensive and subjective, or interpreted as unstable. With the development of sensory methods (CIVILLE and SZCZESNIAK, 1973) and statistics, to ensure objective results with a precision comparable to that of most other instruments, these arguments are no longer valid. The argument that instruments are more practical for several applications is still valid (VIRGILI and PAROLARI, 1991), and there will continue to be an effort to imitate or substitute human evaluation of foods. Although the cost of a trained sensory panel is high, it can be utilised for the description of a large spectrum of

attributes, including appearance, colour, flavour, odour and texture. Instruments are also increasing in price, and are often limited to spectrum of parameters. However, the potential of rapid non-destructive techniques, such as NIR spectroscopy, will perhaps give impetus for instrument development (NÆS and KOWALSKI, 1989). In addition, with the inclusion of multivariate statistics interpretation of data, the complexity of human perception might be simulated well enough for usage in a variety of industrial applications. But, for a long time, human perception of meat products will best be described by the use of sensory evaluation.

METHODS FOR SENSORY EVALUATION AND PREFERENCE MEASUREMENTS: Because sensory science is a science with a lack of formal training, there is a great potential for dangerous misuse of sensory methods. The detection of such in current sensory work requires a knowledge of all of the experimental procedures, which, unfortunately, some reports do not. This report will discuss several specific mistakes that were found in the recent literature. There are, of course, lots of traits and difficulties in evaluating the works done by others, since very often necessary information is not available in the report. But, certain common errors should be commented on since they still occur in 1992:

The use of "just-about-right" scales. Such scales very often go from "too little" to "just right" and then to "too much" of an attribute, but they can also be organised from +5 = ideal, to 0 = neither good nor bad, to -5 = poor (BEJERHOLM and BARTON-GADE, 1986; BUCHTER and ZEUTHEN, 1971). Other examples of this principle are scales from "less acceptable", to "acceptable" to "extremely acceptable" (BEJERHOLM and BARTON-GADE, 1986) or from "extremely flavourful" to "extremely bland" (CHASTAIN et al, 1981).

Common for the use of these scales is that they very often combine the description of an attribute with preference for the attribute (BUCHTER and ZEUTHEN, 1971). These two properties become difficult to resolve when both untrained consumers describe products and trained panels try to indicate preference. In both cases it will be difficult to distinguish between which effect is caused by samples being different, and which effect is caused by consumers/individuals having different preferences for attributes. These two effects will always be confounded in such an experiment, and significant differences in preference are more often a function of familiarity with products than a function of the scale used. That is, familiar products, for which individuals have already developed a preference, will give significant differences, and unfamiliar or novel foods, for which preferences are not yet formed, will just induce noise in measurements.

It is also common with the use of these scales to assume that all individuals/consumers prefer the same (otherwise more sophisticated statistics will have to be involved), and that lack of acceptability is a fixed measure opposite to extremely good. Both of these assumptions are rather contentious.

Expanded triangular tests. Triangular tests are designed for the experimenter to be able to have a fair chance of detecting differences between samples, if they exist. In other words, a triangular test is meaningless if differences between the samples are trivial and/or obvious to the participants in the test. With barely detectable differences between the samples in the test, it should be obvious that add-on questions like "which one do you prefer?" are meaningless. The same objections apply to scaling differences for specific attributes, which also are very common in literature. (SKJELKVAALE et al, 1973, GRIFFIN et al, 1982, SEYDI and TOURAILLE, 1986, CHASTAIN et al, 1981).

To complicate things further, it is necessary to ask two questions: 1) How can preference or descriptive data from an assessor who did not pick out the odd sample in the triangular test be included in a statistical evaluation of the test results?, and 2) Did the assessor pick out the odd sample in the test because the samples were different or because the assessor was good at guessing? This second question, essential for triangular tests, indicates that it is doubtful whether so called "correct" answers can be included in such scaling evaluations in combination with a triangular test.

The current complexity of profiling data analysis might motivate a substitution with the simpler data analysis of triangular tests, since this also includes a conceptual confusion, it is difficult to implement.

Preferences from trained panels. The most commonly made mistake is to include preference variables in a descriptive profile in which trained panels are utilised (RAY et al, 1985, CROSS et al, 1987, USBORNE, 1970, EADIE et al, 1990).

In sensory profiles attributes are often described in the following order: Colour/appearance, odour, flavour, and texture.

ling studies, one frequently finds that one or more hedonic attributes are added at the end of the profile. These attributes are called ptability, preference or overall acceptability. It is unfortunate that many workers using a profile for description of variation in a erial, only discuss the overall acceptance (USBORNE, 1970). In addition, if preference measures are collected from as few as 4 more ss trained assessors (MARRIOTT et al, 1980, BATCHER and DAWSON, 1960), and if the assessors frequently show indications of g strongly involved in meat research (FALK et al, 1975, RAY et al, 1985), the outcome of this part of the test should be strongly bted until verified in other studies. For example, if a test contains results that are identical to these of separate consumer tests with tion criteria, reflecting representativity or other relevant variables, such an outcome can be purely coincidental.

Preference measurements: In most works, in which preference attributes are measured, the selection procedures and other controlled ors of importance for the results are rarely described (JOHNSON et al, 1990). In fact, regular consumers are not used at all in the ority of studies (KLETTNER, 1989, VAN LAACK and SMULDERS, 1989, SAVAGE et al, 1990, BROEKHUIJSEN and VAN LLINGEN, 1990, BUCHTER and ZEUTHEN, 1971).

Description of consumer segments is necessary whenever preference is measured to describe how consumers are selected for icipation in the test (HOUSTON and COURINGTON, 1990). Few authors seem to emphasise this and to report this in a satisfactory (CHASTAIN et al, 1981, SAVELL et al, 1987).

Even fewer scientists report situational and cognitive factors that influence the experiment, although good examples do exist EISELMAN et al, 1988).

It is also somewhat disappointing to find that in most reports, consumer responses are averaged and standard deviations (SAVAGE l, 1990, JOHNSON et al, 1990) or ranges (MENDENHALL and ERCANBRACK, 1979) used to indicate the degree of disagreement ong consumers. Because consumers will give an individual response, it is questionable to assume that a single group behaviour among m is present, and thus questionable to use such averaging procedures.

IMPORTANCE OF SENSORY ATTRIBUTES FOR PREFERENCE: From the studies evaluated for this paper it is difficult to whether appearance or texture attributes have the greatest importance to consumers. In some studies with trained panels, texture and pearance attributes come out of a multivariate analysis along the same dimensions (NUTE et al, 1987), indicating that these attributes ve confounded information in these studies. If this is the case, it is reasonable to believe that this confounded information might, in a ilar way, also affect consumer responses and give strong random effects on results from consumer studies. For example, changes in at texture can also, very often, be seen as colour changes or as changes in geometrical attributes. It is possible that these effects will picked up by consumers in different ways, and that this might cause disturbance in the results. Preference for textural changes and riations in colour-/appearance will undoubtedly be judged in different ways by consumers, depending on whether their attention is used on texture as their main cause for preference or on colour/appearance. Appearance and texture will thus probably not give identical sponses when preference is measured using a material in which these effects are confounded.

Therefore, it is difficult to decide from past research whether appearance or texture is the most important factor for preference, although th of them are found to be important.

Appearance/colour. Appearance factors in published reports comprise to a large extent colour attributes. Several works have related se to various processing factors, such as roasting (CORNFORTH et al, 1982), and cooking (MARTENS et al, 1982). An overview of ese factors are given by RENERRE (1990).

An exact definition of appearance attributes could not be found in any paper that was selected for this review. In many cases, pearance is referred to as "desirability" (CORNFORTH et al, 1982), or with other ambiguous terms such as "low in appearance and ting qualities" (CORNFORTH et al, 1982), or with reference to visibility factors for fat marbling (CHASTAIN et al, 1981, SAVELL al, 1987). The last definitions refer to qualities that can be measured, either through national standards (SAVELL et al, 1987), or through sign factors, such as the level of IMF (BEJERHOLM and BARTON-GADE, 1986), or others (SEYDI and TOURAILLE, 1986).

Unfortunately, it has not been possible to find works in which colour attributes are described with reference to the same colour system r both instrumental and sensory measurements. Such a work could provide improved interpretation of colour attributes for preference.

Multivariate analysis of sensory profiles gives a wide variation of results. Sometimes, appearance attributes, including colour, the greatest variation in the material, while at other times appearance attributes are confounded with texture attributes and descr second and third dimensions in the analysis. It is doubtful whether any of this confusion has a relationship to preference; it is mor a function of experimental design and therefore irrelevant.

Flavour/odour. The relationship of proper meat odours and flavours, as well as off-flavours and off-odours to preference, described in the recent literature. Off-flavours are caused by several factors, such as processing, as with irradiated meats, (RISVIK, or hormonal changes in the animal, as with boar taint (RØDBOTTEN et al, 1990). It is agreed that these off-flavours are unde although the method of determining the rejection levels of these components, if they can be determined, is unclear from most re

The chemical compounds that contribute to meat flavour are to some extent determined in works that use GC-MS and GC-O techniques (MOTTRAM and EDWARDS, 1983, FARMER and PATTERSON, 1991). Still, very little is known about the eff preference of these chemical components.

Since the flavours of meats are not necessarily a linear function of the fat percentage (CHASTAIN et al, 1981, LANGLOIS it makes sense to question whether meat flavour is solely related to fat or whether to properties of the protein fraction as well (FA and PATTERSON, 1991).

Texture. The most frequently found reports deal with aspects of texture changes that are caused by a wide range of factors, these are perceived by trained laboratory panels and consumers (SZCZESNIAK, 1968, KLETTNER, 1989). Although very few have convincing consumer work in this field, it seems accepted that juicy and tender meats (BEILKEN et al, 1990) are preferred that are less tender and less juicy, and that these attributes at large are the most important for the determination of preference (re texture). Less evident are the underlying indications in these results of a simpler structure for the understanding of meat texture.

Multivariate analysis of texture profiles, such as the work on Duroc (CAMERON et al, 1990, DRANSFIELD et al, 1984), that juiciness and tenderness are independent attributes. A similar structure is indicated by the work of NUTE et al (1987), in wh separate along a GPA (Generalized Procrustes Analysis) (GOWER, 1975) dimension indicating that tenderness and juiciness are res for major parts of this variation. Similarly, the most impressive work performed by HARRIS et al (1972), describe "toughness-ten and "juiciness" as separated into two factors in a PCA (Principal Components Analysis) of 69 beef roasts, indicating that tenderne juiciness are two independent phenomena. Some of these aspects are also indicated by COVER et al (1962).

Unpublished work (RISVIK, 1986), involving PCA analysis of a sensory profile of 36 pork samples, selected from 3 breeds to get a maximum variation of IMF at slaughtering (75-80 k), gave a similar result (Fig. 1). The attributes juiciness and fatness dimension one while hardness and chewing resistance fell along dimension one and two, opposite to juiciness and fatness.

HORSFIELD and TAYLOR (1976) describe a system of 3 independent principal components; succulence, toughness and flavo in this order contributed to the prediction of acceptability.

To give names to principal components (that is: to indicate causal relationships) should only be done when results are confirmed studies, designed for this purpose, and performed by several independent groups. However, it is difficult to resist such an opportu

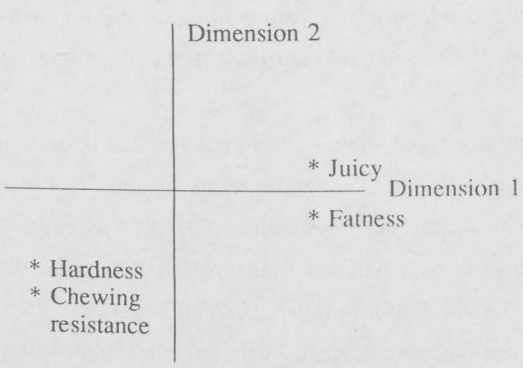

Figure 1 *Possible model for perception of meat texture. Unpublished material* (MATFORSK, 1986)

the labels "perception of water & fat" and "percep structure" seems obvious for principal component one respectively (see fig. 1). This would simplify future preference of meat texture since the attribute juicine directly along dimension one and tenderness falls dire dimension two. If the assumption holds, and it should b further, it will be sufficient to provide tender and juic consumers to ensure preference for the meat texture. T simplify tedious consumer work considerably, since ind preference can easily be obtained through the use o sensory panels.

CONCLUSIONS: There is need for more work in the area of "Sensory Properties and the relationship to Preference". It may be that per consumer segmentation will show that different segments have different preferences and that the focus on properties (appearance/ flavour versus texture) is different for these segments.

The proposed simplified model for texture perception, where tenderness and juiciness are the most important attributes both for description and for preference, should be confirmed before established as a simplified model.

It is a great need for more qualified consumer work to establish relationships between exogenous and endogenous factors and preference of meats.

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